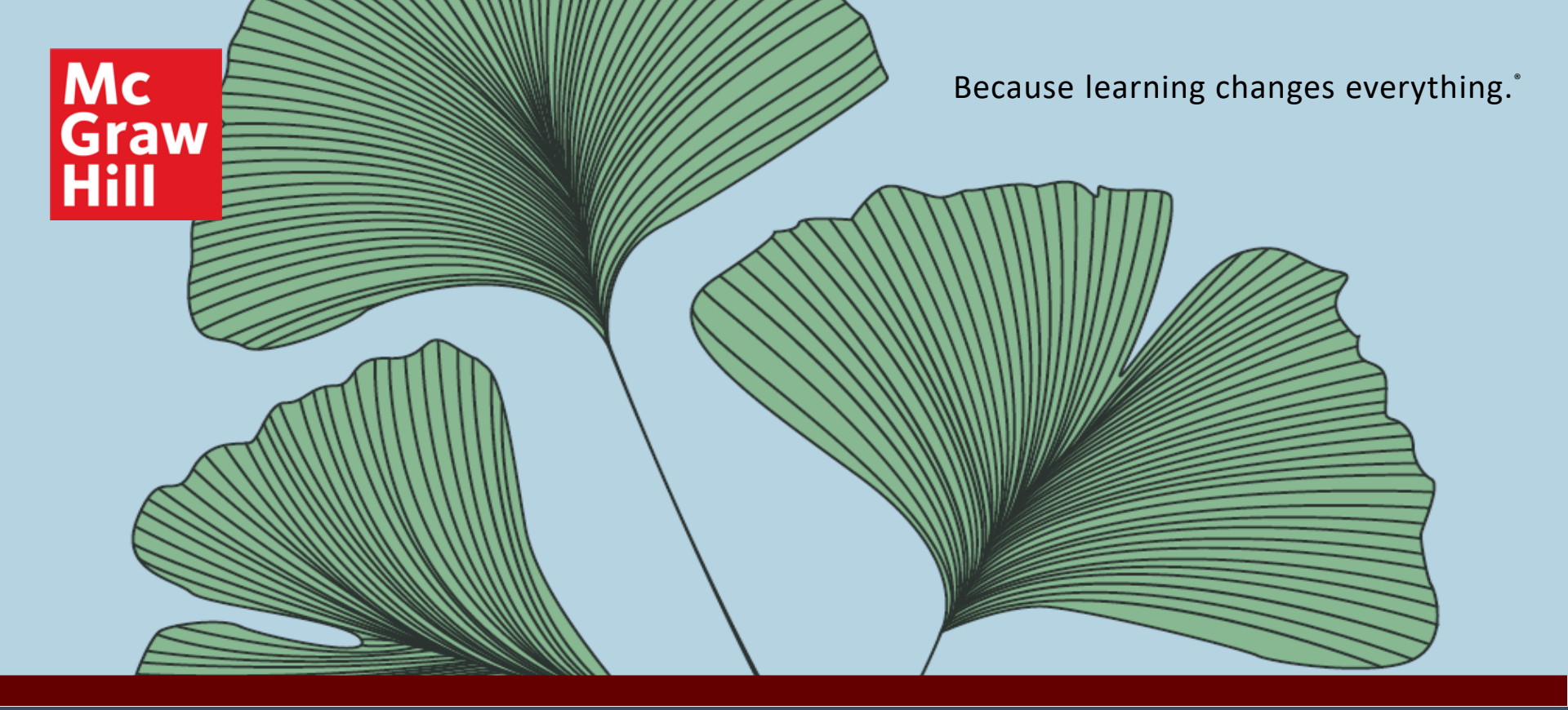

Because learning changes everything.®

Chapter 5

Economic Growth, Productivity, and Living Standards

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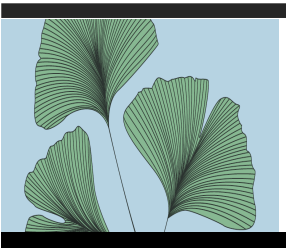

Learning Objectives

1. Show how small differences in growth rates can lead to large differences in living standards.
2. Explain why GDP per capita is the product of average labor productivity and the proportion of the population that is employed and use this decomposition to discuss the sources of economic growth.
3. List the determinants of average labor productivity within a particular country and use these concepts to analyze per capita GDP differences across countries.
4. Discuss the relationships between real GDP and economic well-being.
5. Identify the costs of increasing economic growth.
6. Evaluate government policies that promote economic growth.
7. Analyze whether having finite resources implies that there are limits to growth.

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Benefits of Growth

In the late 18th and early 19th century.

- Life expectancy was 40 years.
  - Most families had 2 or 3 children die.
- Nothing moved faster than the speed of a horse.
- The best highway was from Boston to New York.
  - A stagecoach made the 175-mile trip in 3 days.

Pace of technical change is accelerating.

- Inventions are not sufficient to create growth.
- Products must be commercialized and sold.

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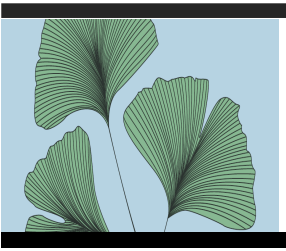

Living Standards

Use an economic model to study the remarkable rise in living standards.

- Real GDP per person is a measure of the goods available to a typical person.

One clue to growing prosperity in the 20th century – GDP per person in 2010 was 12 times greater than it was in 1870.

Comparisons across long periods are complicated by lack of data.

- The variety, quantity, and quality of goods increased enormously in the 19th and 20th century.

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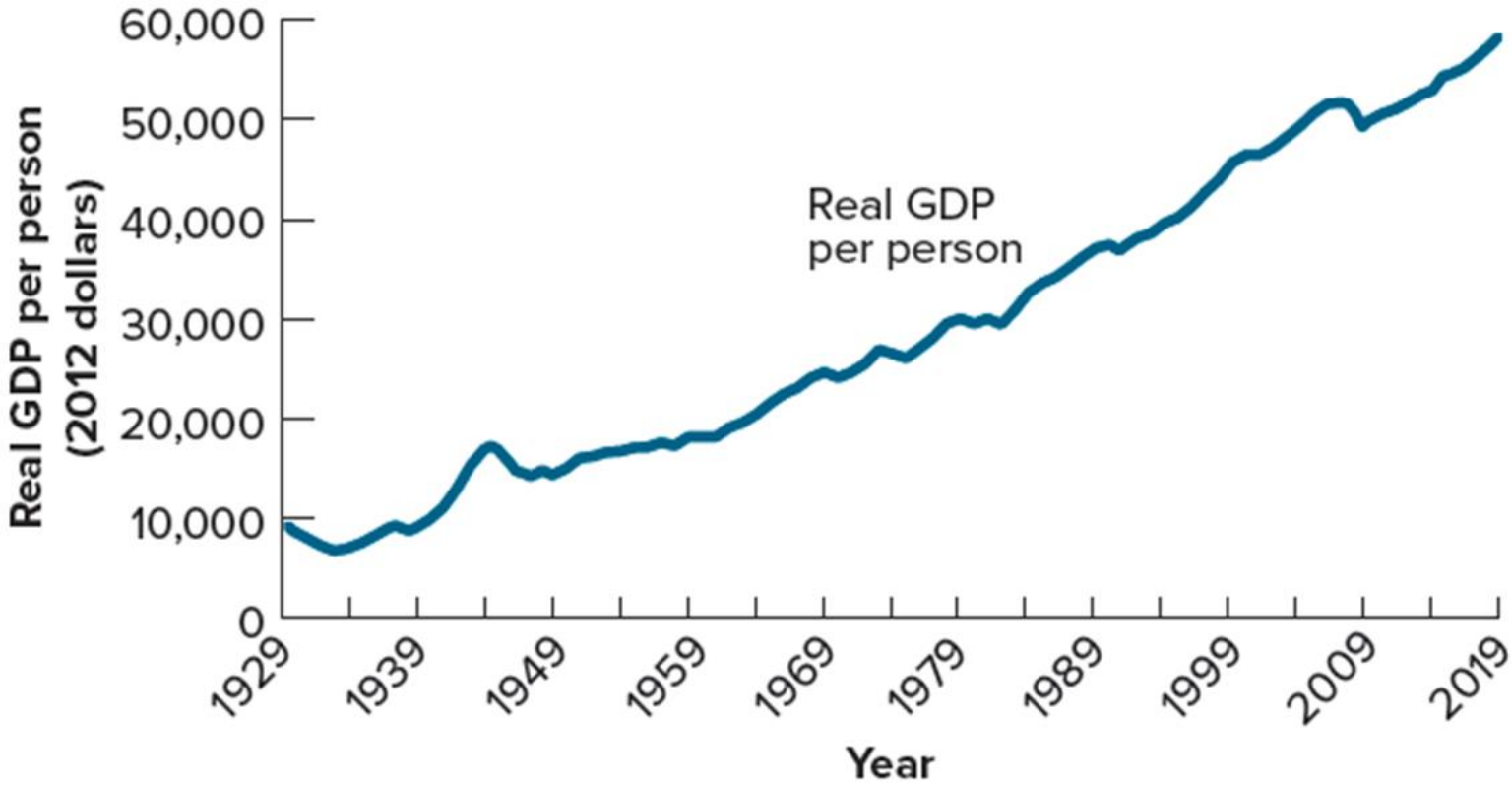
Real GDP per Person in the U.S., 1929-2019



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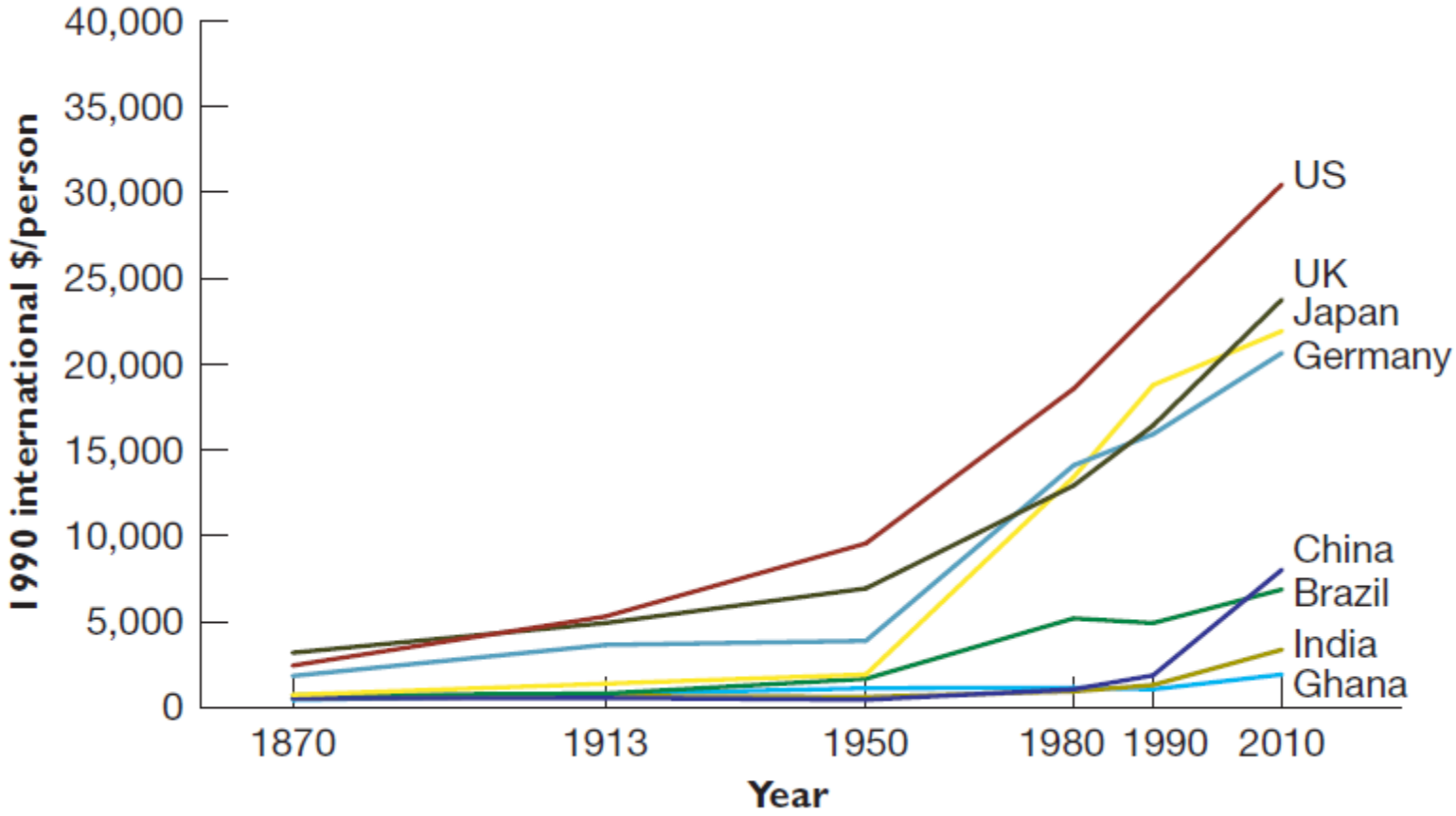
Real GDP per Person, 1870-2010 (in U.S. Dollars)



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Real GDP per Person, 1870 - 2010

Country	1870	1913	1950	1980	1990	2010
U.S.	$2,445	$5,301	$9,561	$18,577	$23,201	30,491
UK	3,190	4,921	6,939	12,931	16,430	23,777
Germany	1,839	3,648	3,881	14,114	15,929	20,661
Japan	737	1,387	1,921	13,428	18,789	21,935
China	530	552	448	1,061	1,871	8,032
Brazil	713	811	1,672	5,195	4,920	6,879
India	533	673	619	938	1,309	3,372
Ghana	439	781	1,122	1,157	1,062	1,922

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Growth of Real GDP per Person, 1870 - 2010

Country	Annual % Change 1870 – 2010	Annual % Change 1950 – 2010	Annual % Change 1980 - 2010
US	1.8%	2.0%	1.7%
UK	1.4	2.1	2.1
Germany	1.7	2.8	1.3
Japan	2.5	4.1	1.6
China	2.0	4.9	7.0
Brazil	1.6	2.4	0.9
India	1.3	2.9	4.4
Ghana	1.1	0.9	1.7

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Compound Interest Rates

In 1870, China's output per person was about 120% that of Ghana's.

- By 2010, China had more than 4 times that of Ghana's.
- China's growth over the period was 2.0% and Ghana's was 1.1%.

Compound interest pays interest on the original deposit and all previously accumulated interest.

- Interest paid in year 1 earns interest in year 2.
- $10 deposited at 4% interest in 1820 is $25,507.50 in 2020.
  - $\$10 \times (1.04)^{200} = \$25{,}507.50.$

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Compound Interest

Differences in interest rates matter.

Interest Rate (%)	Value of $10 after 200 years
2	$524.85
4	$25,507.50
6	$1,151,259.04

Growth rates in GDP per capita have the same effect as interest rates.

- Relatively small growth in GDP per capita has a very large effect over a long period.

In the long run, the growth rate of an economy matters.

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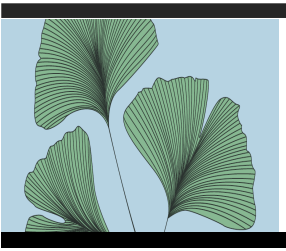

Years to Double

- Useful formula to approximate the number of years it takes an initial amount to double.
- Given some annual interest rate.
- Years to double = 72 / interest rate.
- If the interest rate equals 2% then it takes 36 years for your money to double.
- If GDP grows at 3% then it takes 24 years for GDP to double.
- Growth rates matter.

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The Crucial Role of Average Labor Productivity

Average labor productivity: output per employed worker.

- Y = real GDP.
- N = number of people employed.
- POP = population.

$$\frac{Y}{POP} = \frac{Y}{N} \times \frac{N}{POP}$$

GDP per capita is the product of output per worker and the share of the total population that is working.

Consumption per person depends on.

- How much each worker produces and.
- The share of people working.

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Understanding Growth 1

GDP per capita increases when.

- Output per worker (Y / N) increases OR.
- The share of the population employed (N / POP) increases.

Between 1960 and 2019,

- GDP per capita increased 222%.
- Output per worker increased 144%.
- The share of the population employed increased from 30% to about 47%.
  - Larger working age population.
  - Increase in female labor force participation.

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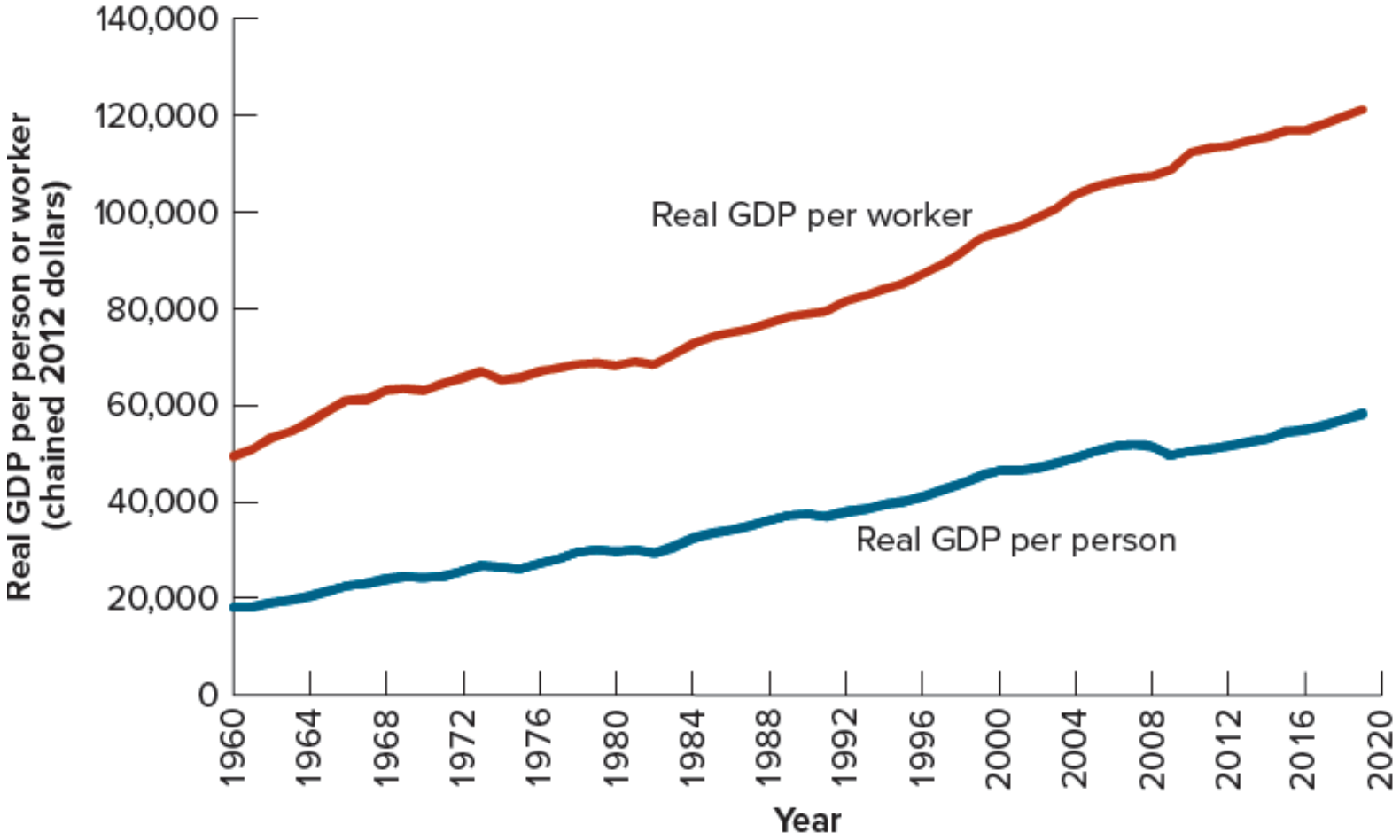
U.S. Real GDP per Person and Average Labor Productivity, 1960-2019



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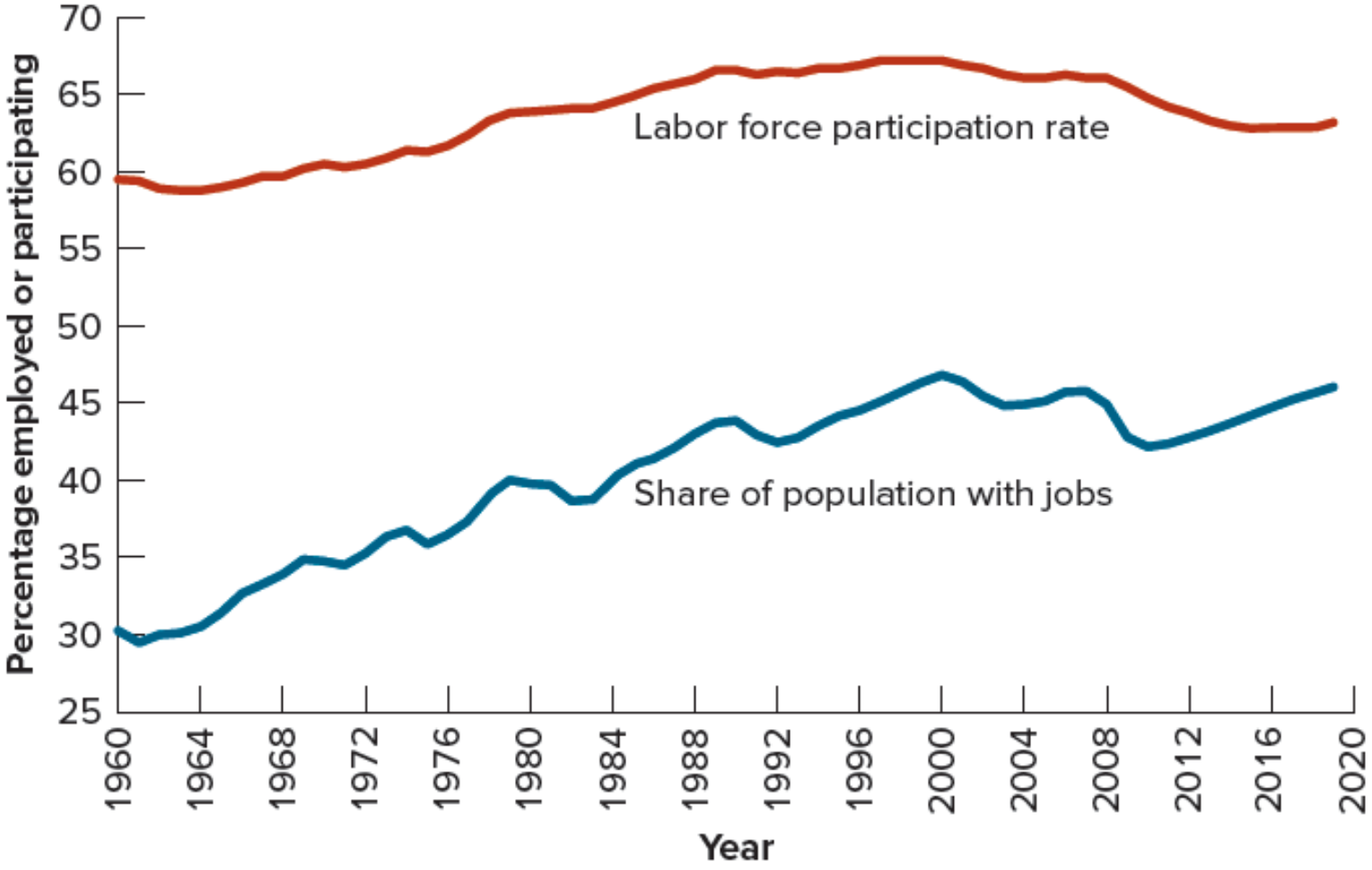
U.S. Population Employed and Labor Force Participation Rate, 1960-2019



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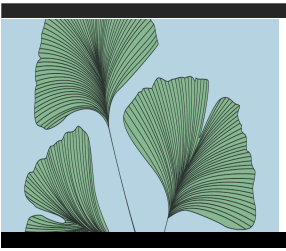

Understanding Growth 2

In the long run,
increases in output per person

and hence living standards
arise primarily from
increases in average labor productivity

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Determinants of Average Labor Productivity

U.S. average labor productivity is.

- 12 times that of Indonesia.
- 39 times that of Bangladesh.

Six factors determine average labor productivity.

1. Human capital
2. Physical capital
3. Land and other natural resources
4. Technology
5. Entrepreneurship and management
6. Political and legal environment

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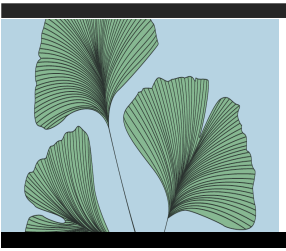

#1 Human Capital

Human capital comprises the talents, education, training, and skills of workers.

- Human capital increases workers' productivity.

Germany and Japan used human capital to rebuild after World War II.

- Professional scientists and engineers.
- Apprentice and on-the-job training emphasized.
- Japanese increased emphasis on early education.

Cost-Benefit Principle applies to building human capital.

- Premium paid to skilled workers.

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#2 Physical Capital

Physical capital is the equipment and tools needed to complete one's work.

More and better capital increases worker productivity.

Candy factory owner employs two people and adds capital.

- Each machine requires one dedicated operator.

Number of Machines	Output per Week	Hours Worked per Week	Candies per Hour Worked
0	16,000	80	200
1	32,000	80	400
2	40,000	80	500
3	40,000	80	500

More capital increases output per hour.

Diminishing returns to capital.

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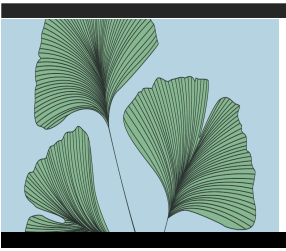

Diminishing Returns to Capital

Diminishing returns to capital occurs if an addition of capital with other inputs held constant increases output by less than the previous increment of capital.

- Assumption: all inputs except capital are held constant.
- Result: output increases at a decreasing rate.

When a firm has many machines, the most productive uses have already been filled.

- The increment in capital will necessarily be assigned to a less productive use than the previous increment.

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Growth and Diminishing Returns to Capital

Implications of diminishing returns.

- Increasing capital will increase output and labor productivity.
  - Positive contribution to growth.
- There are limits to increasing productivity by adding capital because of diminishing returns.

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#3 Land and Other Natural Resources

Inputs other than capital increase worker productivity.

- Land for farming.
  - Farmers are less than 3% of the population and they supply the U.S. and export the surplus.
  - Manufacturing requires raw materials and energy.
- Resources can be obtained through international markets.
  - Japan, Hong Kong, Singapore and Switzerland have high levels of GDP per capita with a limited resource base.

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#4 Technology

New technologies are the *single most important source* of productivity improvement.

Technical change can affect industries beyond the primary application.

- Transportation expanded markets for farm produce.
- Medicine.
- Communications.
- Electronics and computers.

18th century transport

- Horsepower.

19th century transport

Steam engine

- Rail.
- River.

20th century transport

- Road network.
- Air.

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Productivity Puzzle

U.S. labor productivity grew 2.5% from 1948 – 1973.

- Slowed to 1.1% from 1973 – 1995.
- Resurgence to 2.4% between 1995 – 2000.
- 1.5% 2000-2007 and 1.0% 2007-2019.

Slow-down remains a mystery.

- Since 2010, remains to be seen if this is a temporary effect of the last recession or the beginning of a new period of productivity slowdown.

Growth since 1995 is largely attributed to information and communications technologies making workers more productive.

- Growth seen in industries that produce these technologies and industries that use them.
- Slower growth in sectors that do not use these technologies.

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#5 Entrepreneurship and Management

Entrepreneurs create new economic enterprises.

- Essential to a dynamic, healthy, growing economy.

Examples.

- Henry Ford and mass production.
- Bill Gates and standardized graphical user interface operating system.
- Larry Page and Sergey Brin and Google's search.

Policies should channel entrepreneurship in productive ways.

- Taxation policy and regulatory regime.
- Value innovation.

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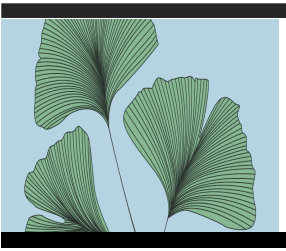

Medieval China

Sung period (960 – 1270 AD) was technically sophisticated.

- Paper.
- Water wheels.
- Gunpowder.
- Compass?

Economic stagnation followed.

- Social system limited entrepreneurship.
- Emperor retained property rights to business.
  - Seizure possible without notice.

Scientific advances alone do not ensure technical change and growth.

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#6 Political and Legal Environment

Encourage people to be economically productive.

Well-defined property rights are essential.

- Who owns what and how those things can be used.
- Reliable recourse through courts.

Maintain political stability.

Promote free and open exchange of ideas.

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Real GDP and Economic Well-Being

Real GDP is a flawed measure of well-being.

- **It values only market transactions.**
  - Omits illegal transactions, volunteer work, and household production.

Maximizing GDP will not necessarily maximize national well-being.

- Whether increases in output increase welfare is a case-by-case issue.

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GDP Does Not Value Leisure

Amount of leisure time has increased in the past 100 years.

- Work weeks are shorter.
- People enter the labor force at an older age.
- People retire earlier.

Leisure produces no goods for market.

- GDP places a value of zero on all leisure time.
- Opportunity cost of an hour of leisure is your hourly wage.
- Omission of the value of leisure time makes GDP seem smaller.

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Nonmarket Economic Activities

GDP omits services that are not traded in markets.

- Household production.
- Volunteer services.

Valuing these services would be difficult.

Nonmarket activities are important in poor countries.

- Self-sufficient households and bartered goods and services.

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Underground Economy

Underground economy is all unreported transactions, legal and illegal.

Casual labor is often paid in cash.

- Failure to report transaction reduces taxes.

Some underground activity is illegal.

- A service of value is provided.
- Drug dealers, organized crime, etc.

Estimates suggest the underground economy is large regardless of national income level.

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Environmental Quality

Suppose a factory is built in your town.

- People are employed and output is produced.
  - Productive activity is included in GDP.

Suppose further that the factory creates pollution.

- Your city hires a company to restore the environment to its initial condition.
- Clean-up activities are included in GDP.
  - Gets environment back to its starting point, not better.

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Resource Depletion

No adjustment is made for the decline in resource availability when mining or other harvesting is done.

- One more barrel of oil on the market means one less barrel for future use.

Environmental quality and resource depletion are difficult to value.

- They have value and that value is omitted from GDP.

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Other Quality of Life Considerations

GDP does not account for intangibles people value.

- Crime rates.
- Traffic congestion.
- Civic organizations.
- Open space.
- Sense of community.

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Poverty and Economic Inequality

GDP does not capture the effects of income inequality.

- Most would prefer living in a relatively equal society to one with a few wealthy and many poor.

U.S. uses an absolute standard of poverty.

- In 2019, a family of four was poor if their income was less than $25,750.

Inequality matters and it is increasing in the U.S.

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GDP as a Welfare Measure

GDP omits and undervalues some goods and services.

GDP per capita is positively associated with several measures of well-being.

- **Material standard of living**: more goods and services.
- **Health and life expectancy.**
  - Residents of industrialized countries fare better than residents of developing countries in a range of health measures.
- **Education.**
  - Literacy and school enrollment rates are higher in high-income countries.

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Costs of Economic Growth

Increasing the capital stock will increase GDP.

Opportunity cost of producing more capital goods is.

- Fewer consumer goods.
  - People may be willing to forego present consumption to have more in the future.
- Reduced leisure time.
- Possible risks of health and safety from rapid capital production.
- The cost of research and development (R&D) to improve technology.
- The cost of education to develop and use new capital.

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Promote Growth with Human Capital

Governments support education and training programs.

- U.S. public education support extends from kindergarten. through institutions of higher learning.
- Head Start program for pre-school children.
- Job training and retraining programs.

Government pays because education has externalities.

- A democracy works better with educated voters.
- Progressive taxes capture some of the higher income.
- Increases chances of technical innovation.
- Poor families could not pay.

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Promote Growth with Savings and Investment

Government policies can encourage new capital formation and saving in the private sector.

- Individual Retirement Accounts (IRAs) are an incentive for individuals to save.
- Government periodically offers investment tax credits.

Government can invest directly in capital formation.

- Construction of infrastructure such as roads, bridges, airports, and dams.
- U.S. interstate highway system reduced costs of transporting goods, making markets more efficient.

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Promote Growth with R&D Support

Research and development promotes innovation.

- Some types of research, such as basic science, create externalities that a private firm cannot capture.
  - Silicon chip.
- Fund basic science with National Science Foundation (NSF) and other government grants.

Government sponsors research for military and space applications.

- Government owns GPS satellites.

Maintain political and legal framework to support growth.

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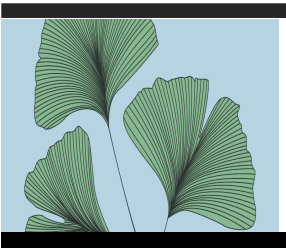

Promoting Economic Growth in Poor Countries

Prescription for more human and physical capital is broadly correct.

- Appropriate technology and education.

Most countries need institutions to support growth.

- Corruption creates uncertainty about property rights and drains financial resources out of the country.
- Regulation discourages entrepreneurship.
- Taxes discourage risk-taking.
- Markets do not function efficiently.
- Lack of political stability discourages foreign investment.

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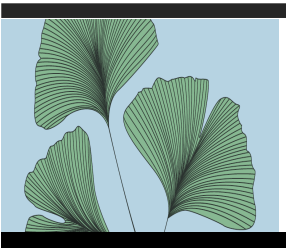

Limits to Growth

Can growth be sustained?

- Depletion of some natural resources.
- Environmental damage and global warming.

Computer models suggested growth is not sustainable.

- Did not adequately treat new and better products.
- Greater income can pay for better environmental quality.
- Ignored the market's response to increasing scarcity.
  - High prices trigger a response.
  - Strong response to energy crisis in mid 1970s.

Government action needed in case of externalities.

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